# Analysis and design of channel interleavers for terrestrial broadcast

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M3 Mobile Multi Media

# Analysis and Design of Channel Interleavers for Terrestrial Broadcast

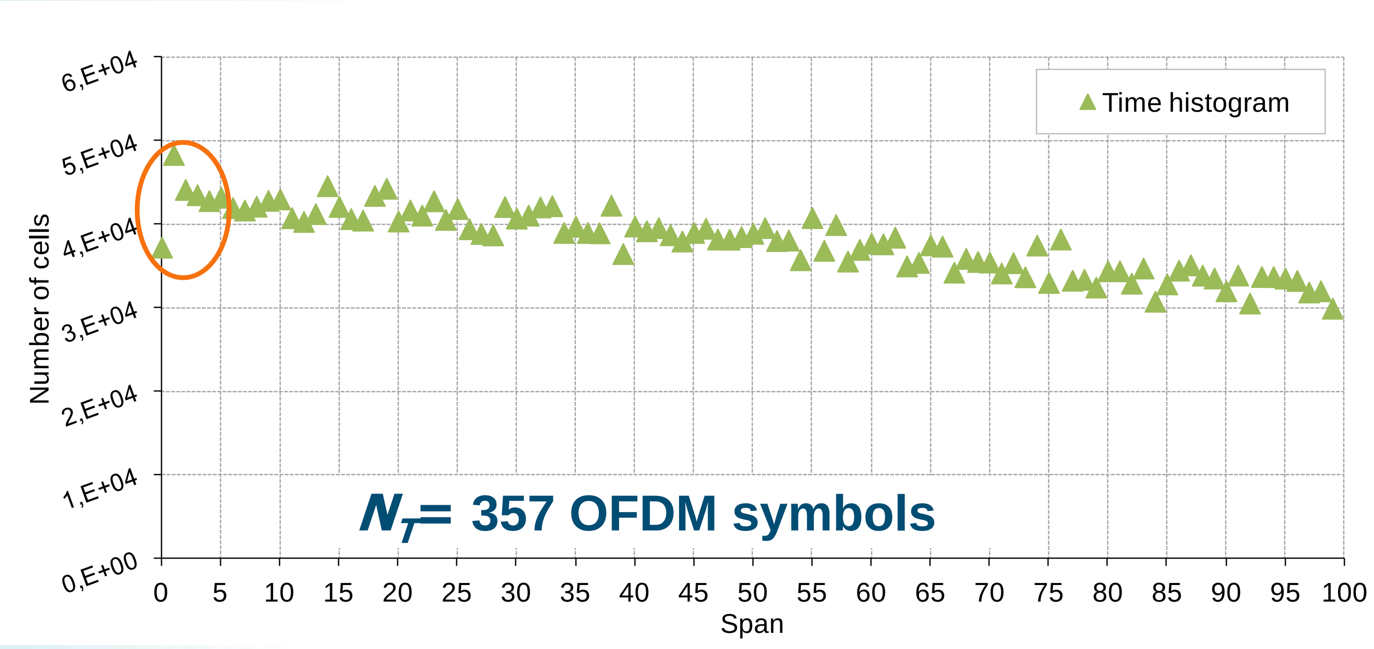
## Motivations

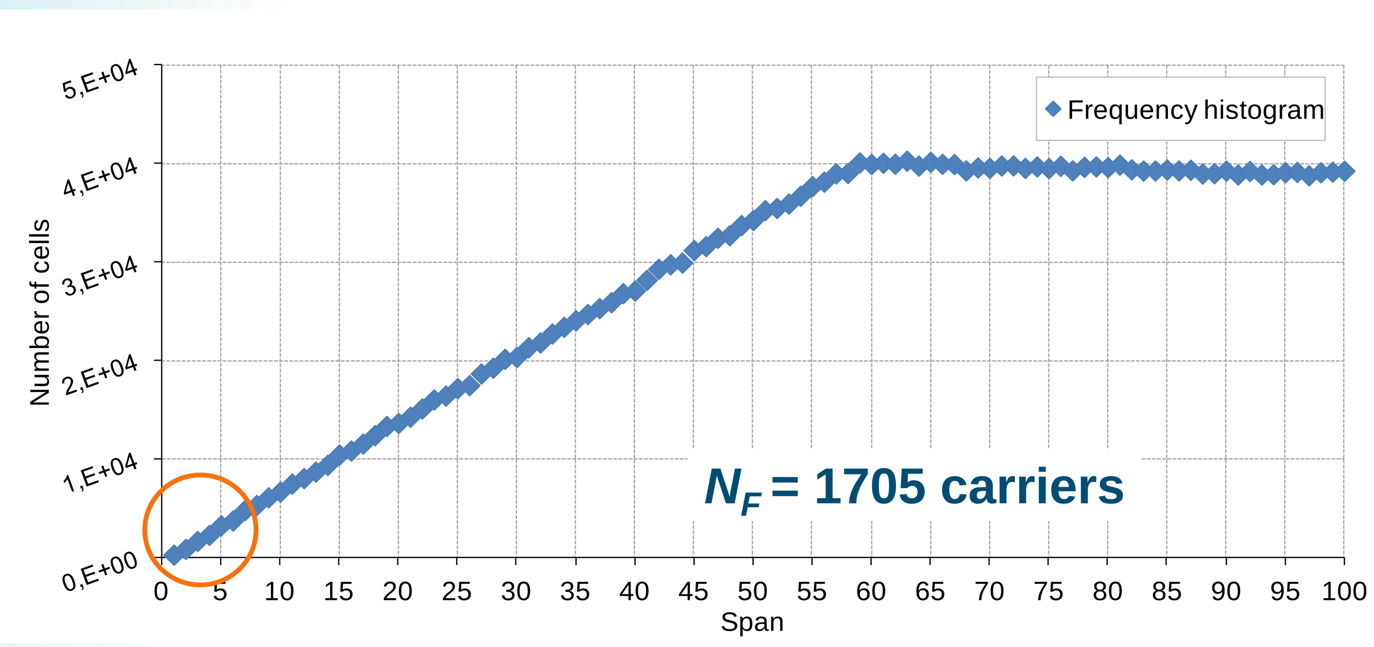
- In terrestrial broadcast standards such as DVB-T2, channel interleaving is achieved through stacking several specific interleavers
  => no global optimization is performed, bad interactions between the different interleavers sometimes occur
- **Aim**: propose design criteria for channel interleavers based on span properties in the time and frequency domains and on the distribution of mutual information (MI)

## Span properties

- **Frequency span**: $S_f(i) = \min_j\left(|f_i - f_j| + |f_{\Pi(i)} - f_{\Pi(j)}|\right)$
- **Time span:** $S_t(i) = \min_j\left(|t_i - t_j| + |t_{\Pi(i)} - t_{\Pi(j)}|\right)$
- **Design criterion**: maximize time and frequency spans

## Analysis of DVB-T2 interleaver




**CI**: Cell Interleaver **TI**: Time Interleaver, **FI**: frequency Interleaver

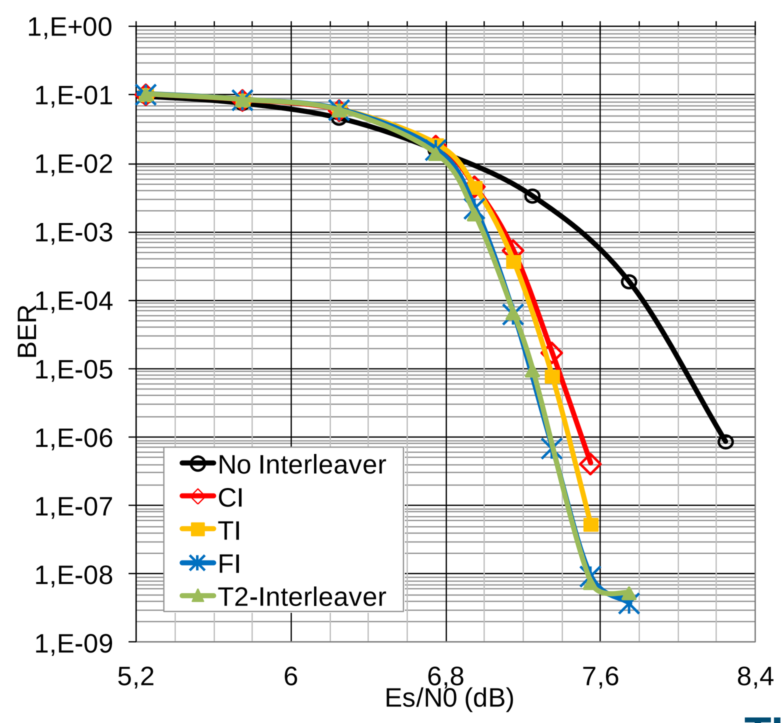
## Mutual information distribution

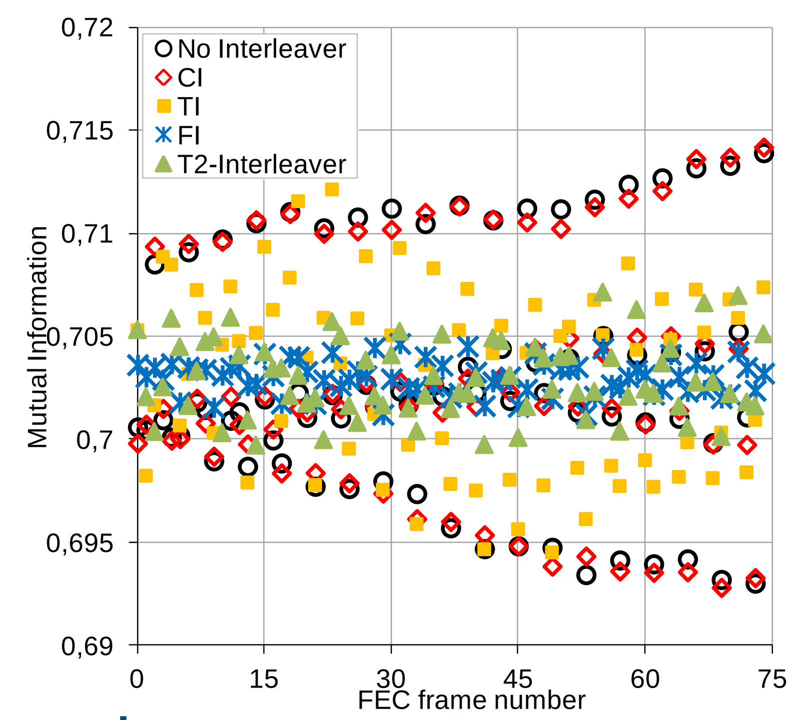
- **Average mutual information** (MI) per FEC block

$$AMI_j = \log 2 - \sum_{i=1}^{N}\left[\max{}^*\left(0, z_i\,(-1)^{b_i}\right)\right]/N$$

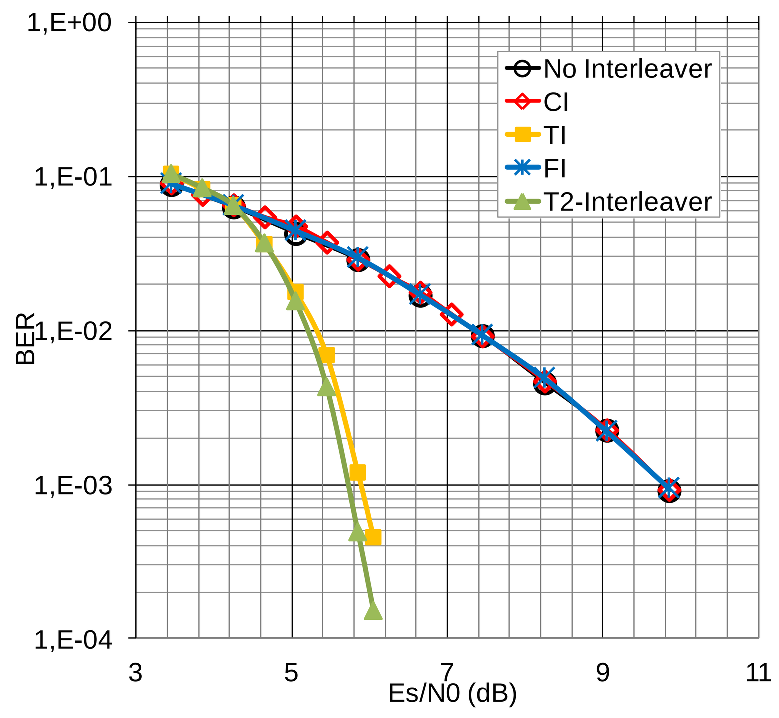
- **Design criterion**: minimize the variance of MI distribution over FEC blocks in the OFDM frame => uniform distribution of the MI

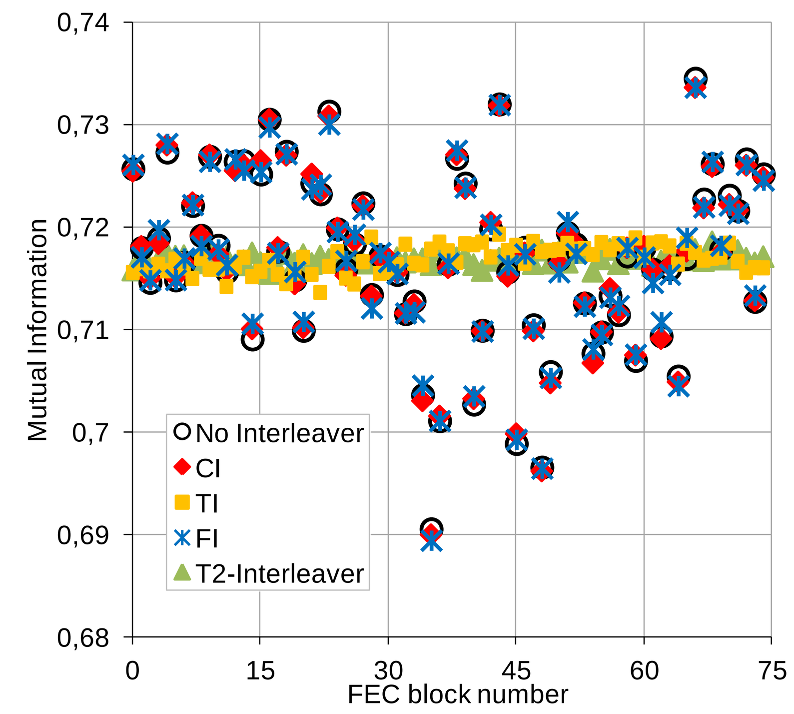
**P1 channel**



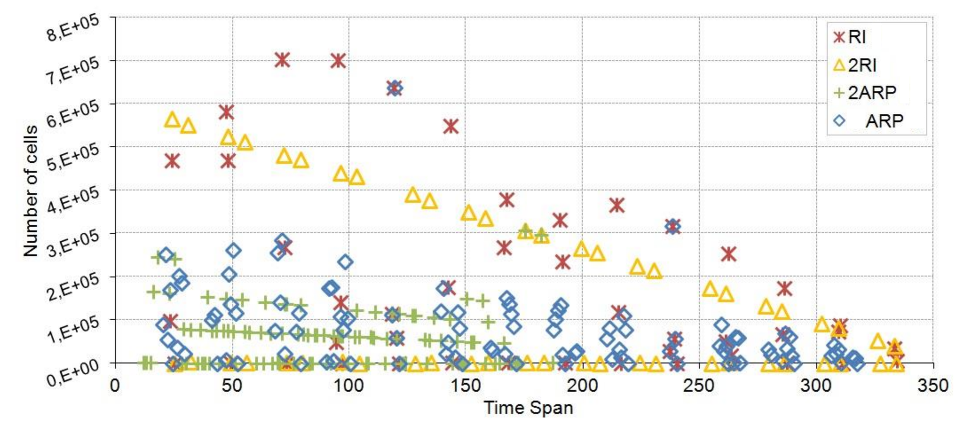

**TU6 channel**

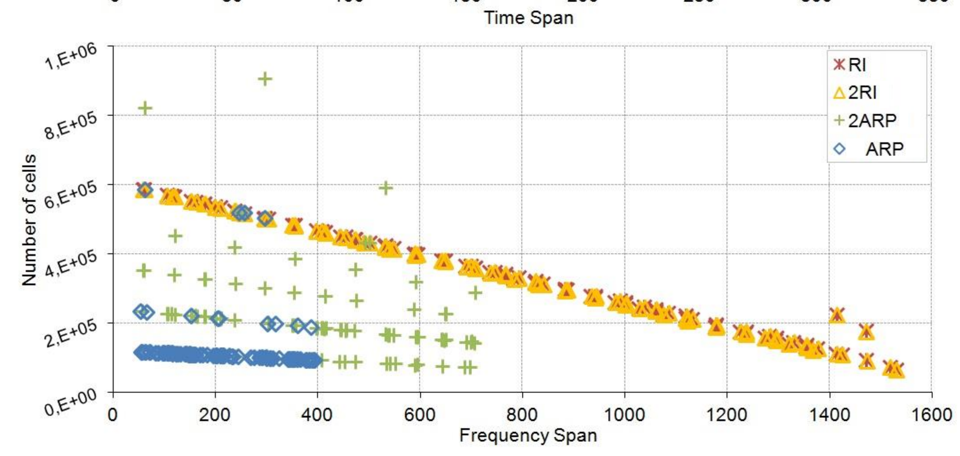


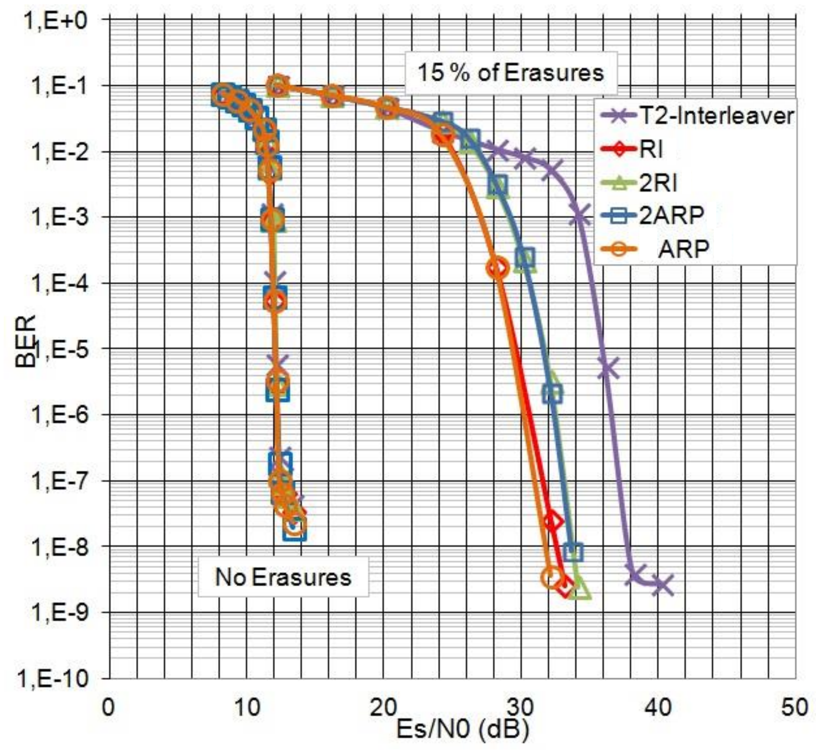




## Design of interleavers with good span and MI distribution properties

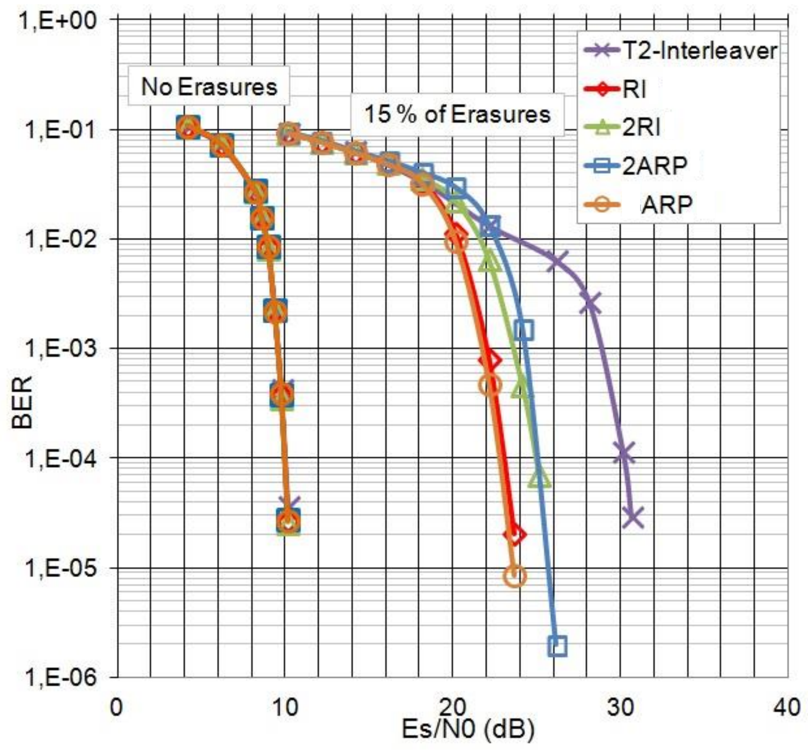
- **Studied interleavers**
  - **Regular interleaver (RI):** $\Pi(i) = P \times i \bmod N_C$ with $P = P_t \times N_F + P_f,\ N_F$ being the number of cells in an ODFM frame
  - **Double regular interleaver (2RI)**: $\Pi(i) = N_F \times t_{\Pi(i)} + f_{\Pi(i)}$ with $t_{\Pi(i)} = (P_t \times \lfloor i/N_F \rfloor + S_T \times i \bmod N_F) \bmod N_T$ and $f_{\Pi(i)} = P_f \times i \bmod N_F$
  - **Almost regular permutation (ARP):** same as RI with cyclic shift in $\Pi(i)$ expression
  - **Double almost regular permutation (2ARP)**: same as 2RI with cyclic shifts in $t_{\Pi(i)}$ and $f_{\Pi(i)}$ expressions




P1 channel, LDPC code rate 37/45




TU6 channel, LDPC code rate 37/45